The Effect of Mild Motion Sickness and Sopite Syndrome on Multitasking Cognitive Performance

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The Effect of Mild Motion Sickness and Sopite Syndrome on Multitasking Cognitive Performance

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Motion Sickness and Sopite Syndrome

- **Motion sickness**
  - A general term describing a constellation of symptoms including stomach awareness, yawning, disorientation, drowsiness, facial pallor, cold sweating, nausea and emesis
  - Neural mismatch (or sensory conflict) theory

- **Sopite syndrome** (identified by Graybiel & Knepton, 1976)
  - Another type of motion sickness
  - A symptom-complex characterized by drowsiness and lethargy related to motion sickness
    - Drowsiness; yawning; disinterest/ disinclination to work; lassitude; mood changes; withdrawal; mental depression
    - Independent of nausea & emesis
Human Performance and Hypothesis

- **Typical Human Performance Findings**
  - Cognitive performance not affected by motion per se
  - Severe motion sickness can result in cessation of performance
  - There have been very few studies on multitasking cognitive performance and motion sickness

- **Hypothesis**
  - Mild motion sickness and sopite syndrome deteriorate multitasking cognitive performance
Experimental Design:
Groups and Sessions  
(N = 39)

<table>
<thead>
<tr>
<th>1(^{st}) Experimental Session</th>
<th>2(^{nd}) Experimental Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block Block Block Block Block Block</td>
<td>Block Block Block Block Block Block</td>
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<tr>
<td>Group A 1, 2, 3, 4, 5, 6</td>
<td>Group A 1, 2, 3, 4, 5, 6</td>
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<tr>
<td>Motion stimulus</td>
<td>Motion stimulus</td>
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<tr>
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<td>Block Block Block Block Block Block</td>
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<tr>
<td>Group B 1, 2, 3, 4, 5, 6</td>
<td>Group B 1, 2, 3, 4, 5, 6</td>
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<td>Block Block Block Block Block Block</td>
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<tr>
<td>Group C 1, 2, 3, 4, 5, 6</td>
<td>Group C 1, 2, 3, 4, 5, 6</td>
</tr>
</tbody>
</table>
Experimental Design: SYNWIN Cognitive Multi-Task

- Counterbalanced (motion)
Results
Symptomatology
Incidence I (MSAQ)

- 23 “Symptomatic” participants
  - At least 1 symptom
- All 16 symptoms are reported
- Symptoms reported per Symptomatic participant
  - $M=6.09$ symptoms ($SD=4.56$, $MD=5$)

Average MSAQ Total per participant in motion conditions
Symptomatology
Incidence II (from MSAQ)

- **Gastrointestinal cluster**
  - Ready to vomit
  - Sick to the stomach
  - Nauseated
  - Queasy
- **Central-related**
  - Faint-like,
  - Like spinning
  - Lightheaded
  - Disoriented
  - Dizzy
- **Peripheral-related**
  - Clammy/cold sweat
  - Hot/warm
  - Sweaty
- **Sopite syndrome-related**
  - Drowsiness
  - Annoyance/irritation,
  - Fatigue
  - Uneasiness
Symptomatology, Performance and Session
### Symptomatology, performance, and session Scores vs Motion Sickness

#### Performance vs subjective metrics

<table>
<thead>
<tr>
<th>SYNWIN Scores</th>
<th>All</th>
<th>Experimental Session 1</th>
<th>Experimental Session 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite</td>
<td>¬ MSAQ G</td>
<td></td>
<td>¬ MSAQ Total ¬ MSAQ C ¬ SSS</td>
</tr>
<tr>
<td>Memory task</td>
<td>¬ SSS</td>
<td></td>
<td>¬ SSS</td>
</tr>
<tr>
<td>Arithmetic task</td>
<td>¬ MSAQ G</td>
<td>¬ MSAQ Total ¬ MSAQ G ¬ MSAQ P</td>
<td>¬ MSAQ Total ¬ MSAQ S</td>
</tr>
<tr>
<td>Visual task</td>
<td>-</td>
<td>-</td>
<td>¬ MSAQ S</td>
</tr>
<tr>
<td>Auditory task</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Multitasking performance is MAINLY associated with:
- Gastrointestinal symptoms
- Soporific symptoms

### Performance scores vs psychophysiological metrics (EGG power)

<table>
<thead>
<tr>
<th>SYNWIN Tasks</th>
<th>All</th>
<th>Experimental Session 1</th>
<th>Experimental Session 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite</td>
<td>¬</td>
<td></td>
<td>¬ (&gt;4 cpm)</td>
</tr>
<tr>
<td>Memory task</td>
<td>-</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Arithmetic task</td>
<td>-</td>
<td>¬</td>
<td>¬ (&gt;4 cpm)</td>
</tr>
<tr>
<td>Visual task</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Auditory task</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Performance decrement is associated with:
- Shift of gastric power to higher frequencies (tachy gastria)

Average values per participant in motion conditions
- Linear or logarithmic fit
- Regression analysis
Performance vs Motion Sickness

Experimental Session 1

- Average values per participant in motion conditions

Experimental Session 2

- Composite Δ=9%
- Memory Δ=25%
- Arithmetic Δ=13%
Skill Acquisition & Reminiscence

- Between-sessions
  - Performance $\Delta$ between the end of ES 1 and beginning of ES 2
  - This effect was NOT associated with:
    - Motion in ES 1
    - Development of mild motion sickness symptoms in ES 1
Conclusions
Conclusions
Overall

- Multitasking cognitive performance deteriorates even in mildly nauseogenic motion environments
  - Composite -9%, Memory -25%, Arithmetic -13%

- Mild motion sickness does not seem to interfere with the reminiscence effect in a novel cognitive multitasking environment
Conclusions

- **Order effect**
  - ES 1
    - Participants seem to overcome mild motion sickness
  - ES 2
    - Symptomatology takes a toll on performance

- **Probable explanations**
  - Task involvement/Task novelty
    - Mental activity reduces severity (Bos, 2011; Correia & Guedry, 1966; Griffin, 1990)
  - Self-motivation
    - Encouragement to suppress symptoms (“cognitive counseling”) (Dobie et al., 1987; Dobie et al., 1989)
Conclusions: Conceptual Modeling I

Symptomatic individuals

Asymptomatic individuals

Nauseogenic motion

Performance decrement

Adaptation

Hypothetical

Severity of symptoms

Multitasking Performance

Time

Static
Conclusions: Conceptual Modeling II

Symptomatic individuals
2nd Session

Asymptomatic individuals

Multitasking Performance

Practice Effect

Time -->

Severity of symptoms -->

Nauseogenic motion

Symptomatic individuals
1st Session

Symptomatic individuals
2nd Session
Why?

Background

- Simple tasks needing automated responses will suffer less from stress than performance in complex tasks (Yerkes & Dodson, 1908; van Hiel & Mervielde, 2007)

- Mental tasks decrease motion sickness severity (Bos, 2011; Correia & Guedry, 1966; Graybiel, 1968)

- Postural control, sensory integration, and disorientation require cognitive and attentional resources
Why II?

- Previous research combined with our results suggest that:

  Motion sickness acts as a **distractor** by absorbing or denying the use of attentional resources.

![Diagram showing the relationship between attentional resources, cognitive tasks, and motion sickness.](image)
The End!

Questions?
Demographics

- 2 data collection phases
- 39 healthy participants
  - 34 M – 5 F
  - Air Force=4, Army=6, Navy=22, USMC=1, Civilian=4, NOAA=1, Other=1
  - O2 to O5 (O2=4, O3=16, O4=14, O5=1
- Equivalent participant groups in
  - Demographics
  - Subjective (MSAQ, MISC, SSS, etc)
  - Psychophysiological (SC, ECG, EGG)
  - 33 of SYNWIN metrics

Differences in visual task
- Group B resets more frequently than group A
  - Number of resets
  - Reset time
  - Reset position

Inter-session interval
- M=6.51d, SD=1.45, MD=7

<table>
<thead>
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<th>Parameters</th>
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<tr>
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<tr>
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<tr>
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<td>185</td>
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<td>Body Mass Index (BMI)</td>
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<tr>
<td>NEO</td>
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<tr>
<td>N</td>
<td>16.4</td>
<td>7.59</td>
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<tr>
<td>E</td>
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</tr>
<tr>
<td>O</td>
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<tr>
<td>A</td>
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<tr>
<td>C</td>
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<tr>
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